

15

Another example antenna system includes the forgoing components and the incident electromagnetic wave is horizontally polarized, a loop axis of the loop antenna is vertically oriented and the operating frequency range is 54 MHz (megahertz) to 890 MHz.

Another example antenna system includes the forgoing components and a circumference of the loop antenna is less than or equal to one tenth of a wavelength of a maximum operating frequency of the antenna system.

Another example antenna system includes the forgoing components and a thickness of the magnetic gain element is greater than or equal to a diameter of the conductor.

According to another aspect there is provided a method. The method includes increasing a magnetic flux density associated with a received magnetic-field component of an incident electromagnetic wave using a magnetic gain element positioned in an aperture defined by a loop antenna, the magnetic gain element comprising a magnetic material that has a relative permeability greater than one for an operating frequency range; and inducing a loop output voltage in the loop antenna based, at least in part, on the increased magnetic flux density.

Another example method includes the foregoing operations and further includes at least one of amplifying the loop output voltage or amplifying a loop output current related to the loop output voltage using an amplifier coupled to the loop antenna.

Another example method includes the foregoing operations and a minimum operating frequency is greater than or equal to 50 MHz (megahertz).

Another example method includes the foregoing operations and the incident electromagnetic wave is horizontally polarized, a loop axis of the loop antenna is vertically oriented and the operating frequency range is 54 MHz (megahertz) to 890 MHz.

Another example method includes the foregoing operations and a circumference of the loop antenna is less than or equal to one tenth of a wavelength of a maximum operating frequency of the antenna system.

Another example method includes the foregoing operations and further includes providing an output signal related to the loop output voltage to a receiver coupled to the loop antenna.

According to another aspect there is provided a system. The system includes a receiver coupled to an antenna system. The antenna system includes a loop antenna including a conductor, and a magnetic gain element positioned in an aperture defined by the loop antenna, the magnetic gain element including a magnetic material that has a relative permeability greater than one for an operating frequency range, the magnetic gain element configured to increase a magnetic flux density associated with a received magnetic-field component of an incident electromagnetic wave, wherein a loop output voltage induced in the loop antenna is based, at least in part, on the increased magnetic flux density and the receiver is configured to receive an input signal related to the loop output voltage.

Another example system includes the forgoing components and the antenna system further includes an amplifier coupled to the loop antenna, the amplifier configured to at least one of amplify the loop output voltage, amplify a loop output current related to the loop output voltage or provide an output impedance corresponding to a characteristic impedance of a transmission line configured to couple the antenna system to the receiver.

16

Another example system includes the forgoing components and the amplifier is positioned adjacent to loop antenna terminals.

Another example system includes the forgoing components and the operating frequency range has a minimum operating frequency of greater than or equal to Megahertz (MHz).

Another example system includes the forgoing components and the incident electromagnetic wave is horizontally polarized, a loop axis of the loop antenna is vertically oriented and the operating frequency range is 54 MHz (megahertz) to 890 MHz.

Another example system includes the forgoing components and a circumference of the loop antenna is less than or equal to one tenth of a wavelength of a maximum operating frequency of the antenna system.

Another example system includes the forgoing components and the a thickness of the magnetic gain element is greater than or equal to a diameter of the conductor.

Although illustrative embodiments and methods have been shown and described, a wide range of modifications, changes, and substitutions is contemplated in the foregoing disclosure and in some instances some features of the embodiments or steps of the method may be employed without a corresponding use of other features or steps. Accordingly, it is appropriate that the claims be construed broadly and in a manner consistent with the scope of the embodiments disclosed herein.

What is claimed is:

1. An antenna system comprising:

a loop antenna comprising a conductor; and

a magnetic gain element positioned in an aperture defined by the loop antenna, the magnetic gain element comprising a magnetic material that has a relative permeability greater than one for an operating frequency range, the magnetic gain element configured to increase a magnetic flux density associated with a received magnetic-field component of an incident electromagnetic wave wherein a loop output voltage induced in the loop antenna is based, at least in part, on the increased magnetic flux density,

wherein the incident electromagnetic wave is horizontally polarized, a loop axis of the loop antenna is vertically oriented and the operating frequency range is 54 MHz (megahertz) to 890 MHz.

2. The antenna system of claim 1, further comprising an amplifier coupled to the loop antenna, the amplifier configured to at least one of amplify the loop output voltage, amplify a loop output current related to the loop output voltage or provide an output impedance corresponding to a characteristic impedance of a transmission line configured to couple the antenna system to a receiver.

3. The antenna system of claim 2, wherein the amplifier is positioned adjacent to loop antenna terminals.

4. The antenna system of claim 1, wherein a circumference of the loop antenna is less than or equal to one tenth of a wavelength of a maximum operating frequency of the antenna system.

5. The antenna system of claim 1, wherein a thickness of the magnetic gain element is greater than or equal to a diameter of the conductor.

6. A method comprising:

increasing a magnetic flux density associated with a received magnetic-field component of an incident electromagnetic wave using a magnetic gain element positioned in an aperture defined by a loop antenna, the magnetic gain element comprising a magnetic material